Indian Institute of Technology Kanpur

AE451A

Experiments in Aerospace Engineering - III

Experiment No. 9

PERFORMANCE ANALYSIS OF CURVED AND STRAIGHT DIFFUSER

Submitted By:

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October 25, 2021

1. Objective

To determine pressure recovery coefficient of a two-dimensional straight and a curved diffusers.

2. Introduction and theory

Wind tunnel: The open-circuit low speed wind tunnel in the laboratory consists of a centrifugal blower driven by a 30 hp electric motor. The blower draws in air from the atmosphere from the vents on the side. A short diffuser section after the blower smoothens the flow before it enters the settling chamber. The honeycomb section and screens in the settling chamber dampen any circulatory motion. The air is further accelerated in the contraction section to deliver air to a test section. A schematic of the tunnel is shown in figure below.
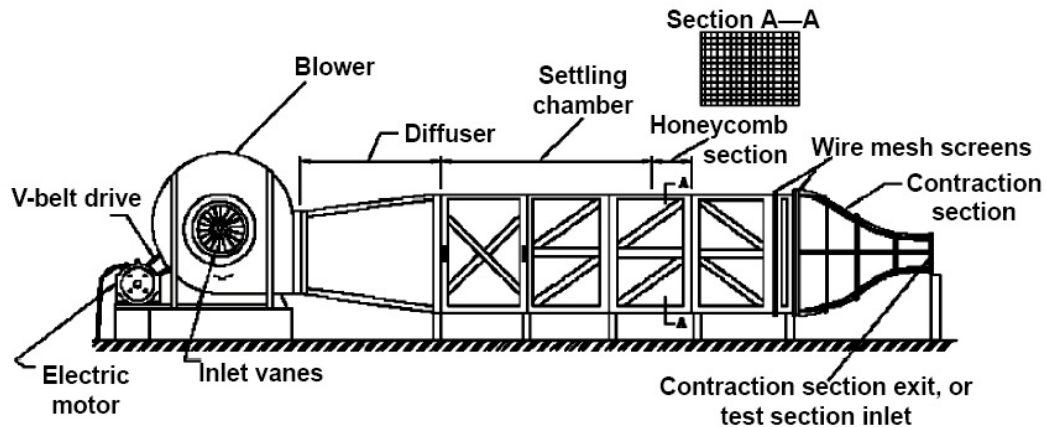

Straight diffuser
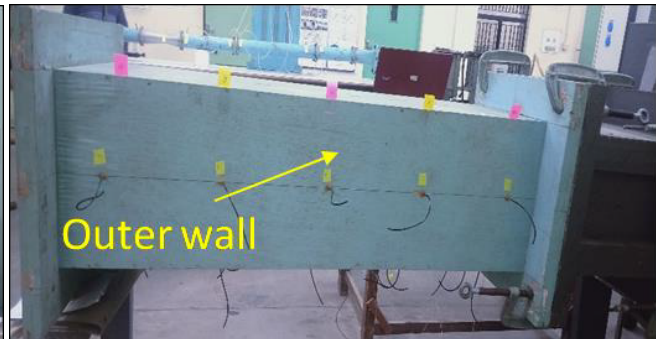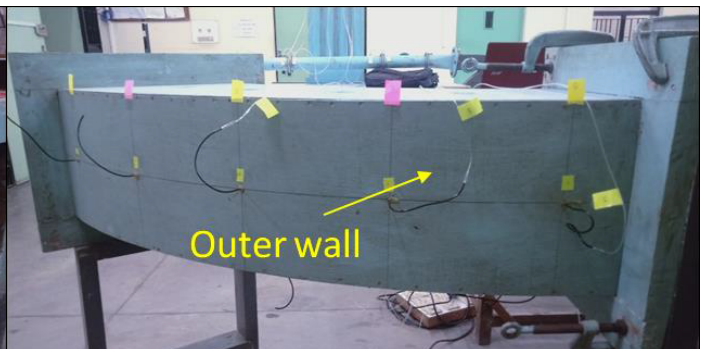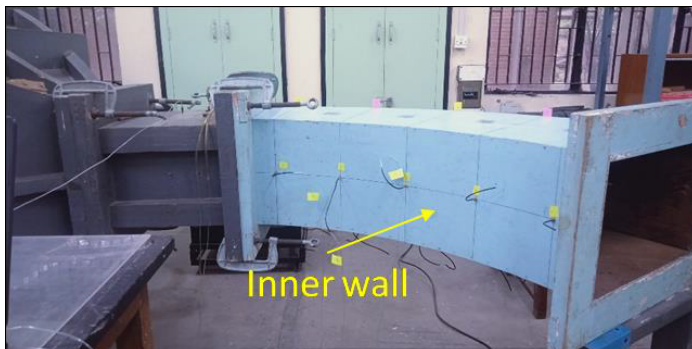
Curved diffuser

3. Equipment's

1. Wind tunnel
2. Two-dimensional straight and curved diffusers
3. Pitot-static tube
4. Pressure sensors

4. Procedure

1. Familiarize with the general layout and major components of the wind tunnel.
2. Sketch the general layout as well as identify the measurement locations for the straight and the curved diffusers.
3. Install the straight diffuser at the wind tunne1 exit and connect the taps with the pressure sensors for observations. Switch on the tunnel and note measurements under steady condition. After completion of observations, repeat the experiment with the curved diffuser for the same fan speed.

5. Measurements

1. Straight Diffuser
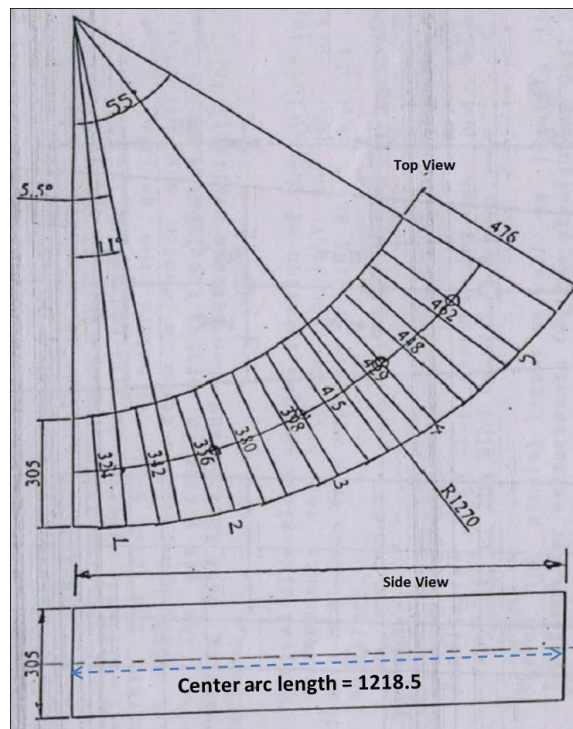

Top View

Side View
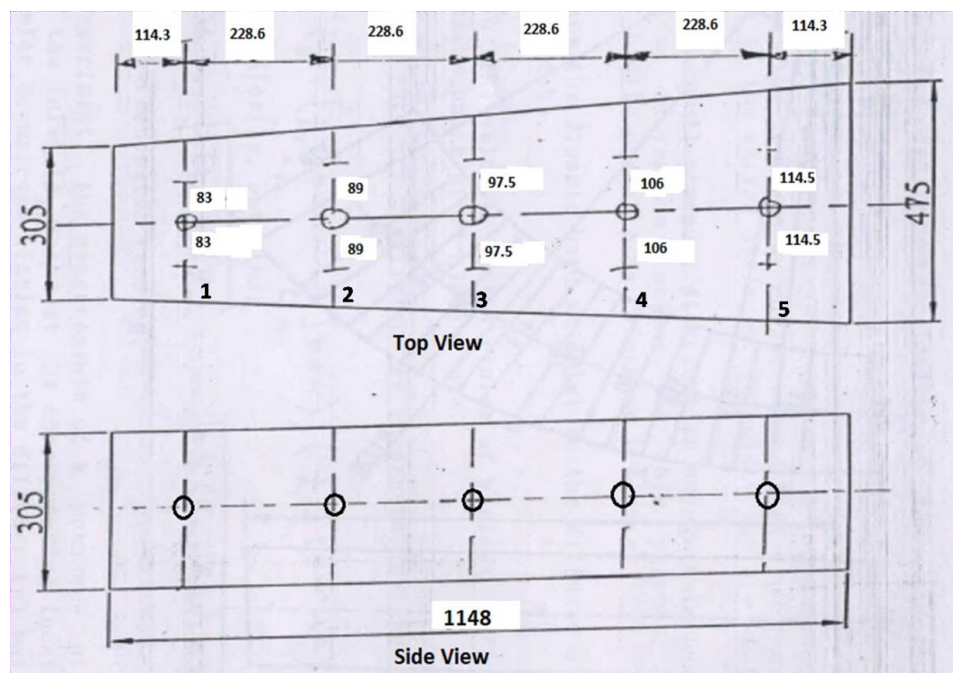
S.No.	Section Name	Dimension
1.	Length	1148 mm
2.	Inlet width and height	305 mm
3.	Outlet width	475 mm
4.	Outlet height	305 mm
5.	Divergent angle	8.445 °

S.No.	Section Name	Dimension
6.	Area ratio	1.5573
7.	Length to inlet width ratio	3.764

2. Curved Diffuser

S.No.	Section Name	Dimension
1.	Center arc length	1218.5 mm
2.	Inlet width and height	305 mm
3.	Outlet width	476 mm
4.	Outlet height	305 mm
5.	Curvature angle	55 °
6.	Area ratio	1.561

6. Calculation

at sea level condition

$$\rho_{air} = 1.225 \ \frac{kg}{m^3}$$

Flow velocity

$$u = \sqrt{\frac{2 * (P0 - P_\infty)}{\rho_{air}}}$$
(1)

> Pressure recovery coefficient

$$C_p = \frac{(P - P_\infty)}{\frac{1}{2} \rho_\infty u_\infty^2}$$
(2)

7. Data analysis

1. **Straight diffuser**

- opening position - 1

uinf	Cp		
31.1263421	-0.941950199	-0.790106523	-0.642161904
31.0723389	-0.618191725	-0.533461855	-0.911169889
31.21283658	-0.79676143	-0.700274467	-0.606546513
31.06922919	-0.796869053	-0.698168764	-0.528816928

- opening position - 2

uinf	Cp		
44.06908989	-0.938852315	-0.803643715	-0.697044115
43.95044415	-0.625100068	-0.521615879	-0.922690339
44.03399601	-0.798864553	-0.713072248	-0.614272081
43.93772511	-0.801445305	-0.722619957	-0.535431193

- opening position - 3

uinf	Cp		
48.02228699	-0.932192121	-0.800755005	-0.695106827
48.27883141	-0.624962821	-0.519680179	-0.922857281
47.97264576	-0.8021845	-0.70903232	-0.611189573
47.85813954	-0.801322316	-0.714719565	-0.535888745

2. **Curved diffuser**

- opening position - 1

uinf	Cp		
30.14849307	-1.064448379	-0.940131449	-0.775679687
30.20383703	-0.676672546	-0.649939912	-0.701741447
31.75299583	-0.519093606	-0.459599014	-0.39777655
31.49409712	-0.523996656	-0.461859822	-0.433575094

- opening position - 2

| uinf	Cp		
41.9416683	-1.045566686	-0.924996635	-0.763234887
41.82945263	-0.655222196	-0.628318623	-0.702901259
41.95214562	-0.571932975	-0.504306684	-0.436274752
42.07103608	-0.570855246	-0.504520449	-0.461053915

- opening position - 3

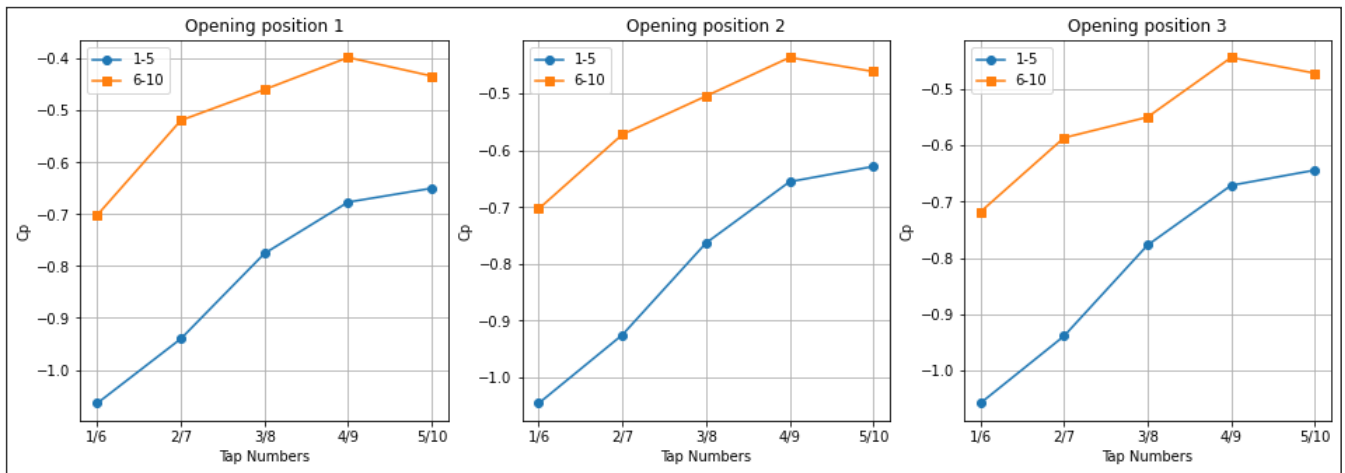| uinf	Cp		
45.24834857	-1.057709612	-0.938639574	-0.777182121
44.94889768	-0.671124327	-0.644147687	-0.71842358
44.94085096	-0.586762005	-0.550070862	-0.444240576
44.78548646	-0.58657151	-0.550729974	-0.472132852

See the tap position in appendix

8. Results and discussion

Straight diffuser
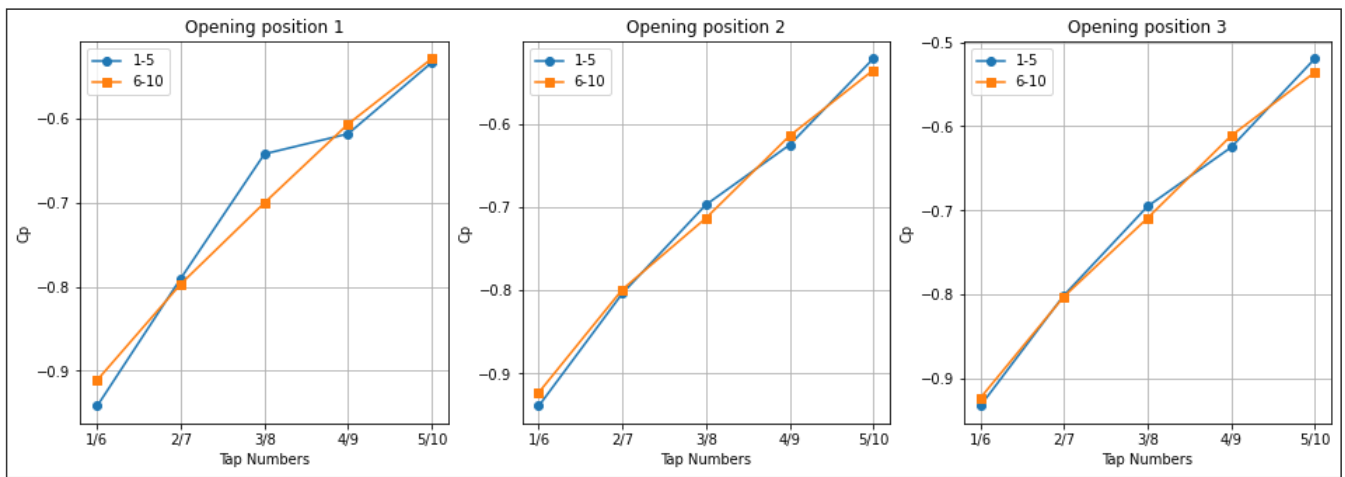
Curved diffuser

9. References

10. Appendix

sensor position

Sensor 1	Sensor 2	Sensor 3	Sensor 4
Pitot	Tap-1	Tap-2	Tap-3
Pitot	Tap-4	Tap-5	Tap-6
Pitot	Tap-7	Tap-8	Tap-9
Pitot	Tap-7	Tap-8	Tap-10